

SIGNIFICANT 2016 ENERGY CODE UPDATES (Effective 1/1/17)

The *2016 Building Energy Efficiency Standards* for residential buildings effective January 1, 2017, include increased efficiencies for several envelope measures. There are improvements that have been made to better aid the designer, builder and building official.

1. Mandatory minimum roof/ceiling construction insulation level must be at least R-22 (maximum U-factor of 0.043).
2. Increased flexibility for prescriptive compliance.
3. The prescriptive requirement of high-performance attics, which includes:
 - a. Insulation installed either above or below the roof deck. (This dramatically lowers the attic the heat from getting into the conditioned space below and reducing HVAC load.)
 - b. Verified ducts in conditioned space.

Mandatory Measures

Mandatory requirements are necessary to support the long-term goal of zero-net-energy buildings. When compliance is being demonstrated with either the prescriptive or performance compliance paths, there are *mandatory measures* that must be installed. Minimum mandatory measures must be met regardless of the method of compliance being used.

Prescriptive Approach

The prescriptive approach is the simplest way to comply with the building envelope requirements but generally offers limited flexibility; however, the 2016 revisions have added increased flexibility for prescriptive compliance. If every prescriptive requirement is met, the building envelope complies with the Energy Standards. The prescriptive envelope requirements are prescribed in §150.1, which includes Table 150.1-A.

The prescriptive compliance approach consists of meeting specific requirements for each envelope component, plus meeting all minimum mandatory requirements, such as mandatory levels of insulation. Prescriptive requirements apply to:

1. Fenestration
2. Roofs and ceilings, including exterior roofing products
3. Exterior walls
4. Floors

Performance Approach

The *performance approach* is a more sophisticated compliance method, and it offers greater design flexibility than the prescriptive approach. The performance approach may be used for any unique design element(s) that the user of a compliance modeling software believes could contribute to the overall energy use of the building.

The performance approach allows for more energy tradeoffs between building features, such as increasing HVAC equipment efficiency to allow more fenestration area.

More restrictive compared to 2013 and moving more towards ZeroNet Residential 2020 and ZeroNet Nonresidential 2030.

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Zero Net Energy (ZNE) – value of energy consumed by the building over the course of a typical year is less than or equal to the value of the renewable energy generated on site.

New Mandatory measures

1. Wall insulation minimum: R-13
2. Ceiling/Roof insulation minimum: R-22
3. Raised floor insulation minimum: R-19
4. Vapor barrier for walls in zones #14 & 16
5. All Zones, unvented crawlspace vapor barrier
6. Maximum fenestration U-factor: 0.58

Example of Wood-Framed wall assemblies and U-factors with Gypsum board interior:

| Stud | Cavity Insulation | Cavity Insulation Type | Exterior Insulation | U-Factor |
|------|-------------------|---|---------------------|----------|
| 2x4 | R15 | High density batt | R4 | 0.065 |
| 2x6 | R21 | Loose-fill cellulose or high density batt | R4 | 0.051 |
| 2x6 | R19 | Low density batt | R5 | 0.051 |
| 2x4 | R15 | High density batt | R8 | 0.050 |
| 2x6 | R31 | Closed-cell spray foam (ccSPF) | R2 | 0.050 |
| 2x6 | R23 | High density batt or mineral wool | R4 | 0.049 |

1. Masonry walls shall be furred to accommodate.
2. Doors with more than 50% glass is considered a glazed door.
 - a. Less than 50% and the glazing is exempt from glazing mandatory and prescriptive requirements but door is subject to 0.30 cfm/sq. ft. leakage requirements

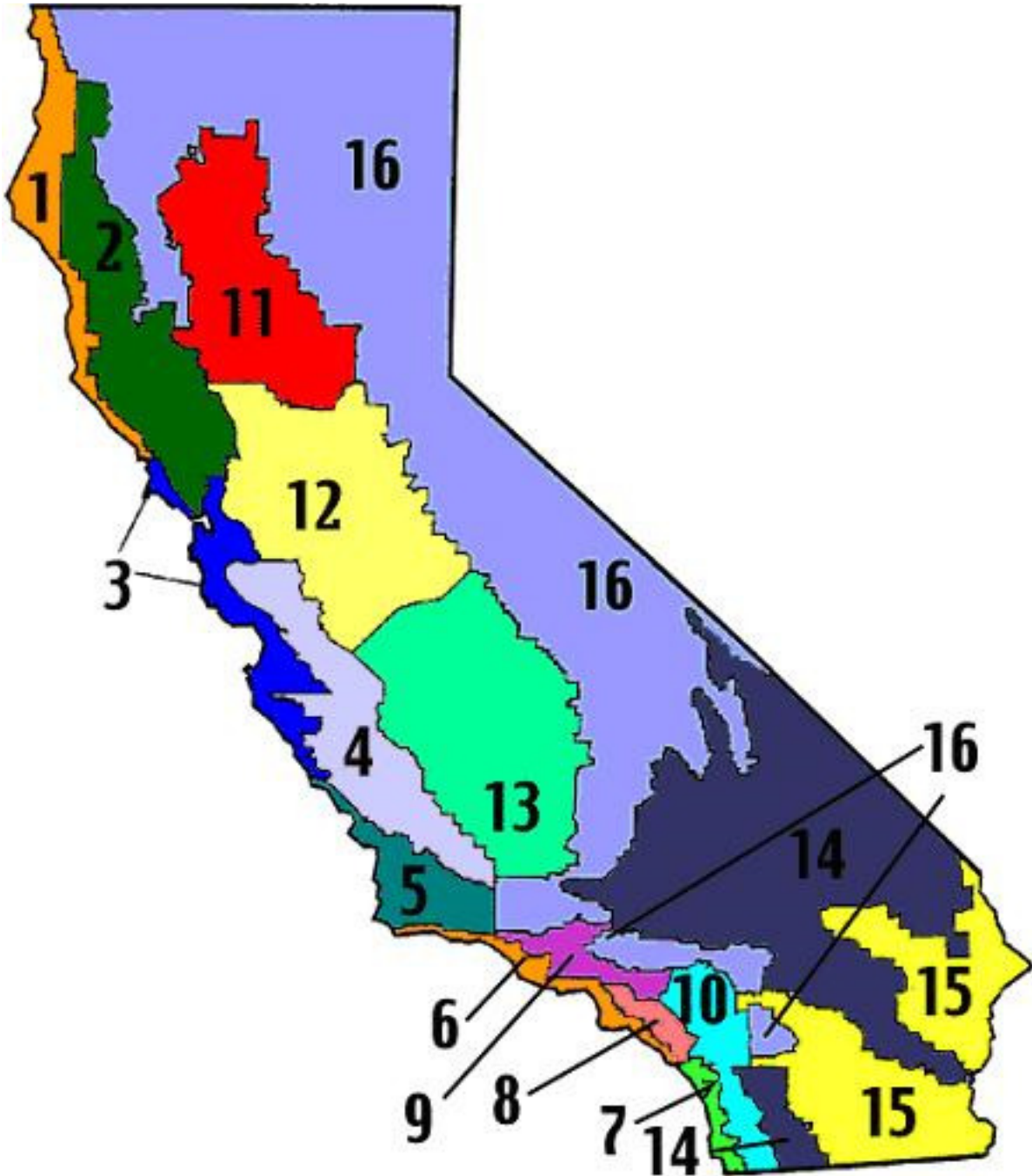
Glazing

Prescriptive requirement

| CLIMATE ZONES | U-FACTOR | SHGG | TOTAL FENESTRATION AREA OF CFA | WEST-FACING AREA OF CFA |
|---------------|----------|----------|--------------------------------|-------------------------|
| 1,3,5 | .32 or < | N/A | 20% or < | N/A |
| 2,4,6-16 | .32 or < | .25 or < | 20% or < | 5% or < |

(Exceptions can be applied. For more information go to <http://www.energy.ca.gov>)

Sixteen Total Climate Zones



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Roofs

Roofing products shall be rated by the Cool Roof Rating Council (CRRC) and labeled appropriately by the roofing manufacturer for both solar reflectance and thermal emittance. The CRRC certification includes solar reflectance and thermal emittance.

There are three kinds of solar reflectance:

1. Initial solar reflectance.
2. Three-year aged solar reflectance.
3. Accelerated aged solar reflectance.

A cool roof reflects and emits the sun's heat back to the sky instead of absorbing and transferring it to the building below. This is measured by SR – solar reflectance and TE – thermal emittance. The true measurement is not the initial, while the product is new, but after it is “aged” or “weathered”.

| | ECOASIS™ PREMIUM (AGAVE) | | ECOASIS™ PREMIUM (MESQUITE) | | ECOASIS™ PREMIUM (TUMBLEWEED) | |
|---|-----------------------------|-----------|--------------------------------|-----------|----------------------------------|-----------|
| | INITIAL | WEATHERED | INITIAL | WEATHERED | INITIAL | WEATHERED |
| SOLAR REFLECTANCE | 0.27 | 0.25 | 0.28 | 0.26 | 0.26 | 0.26 |
| THERMAL EMITTANCE | 0.92 | 0.96 | 0.93 | 0.97 | 0.93 | 0.94 |
| SOLAR REFLECTIVE INDEX (SRI) | 29 | 28 | 31 | 30 | 28 | 28 |
| Related Product ID Licensed Manufacturer ID: 0850 Classification: Production Line | 0850-0020 | | 0850-0018 | | 0850-0019 | |

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Insulation

Prescriptive Requirements for Roof/Ceiling Insulation:

Option A

Vented attic with continuous insulation applied above the roof deck. Ceiling insulation required separately above finished attic ceiling.

Option B

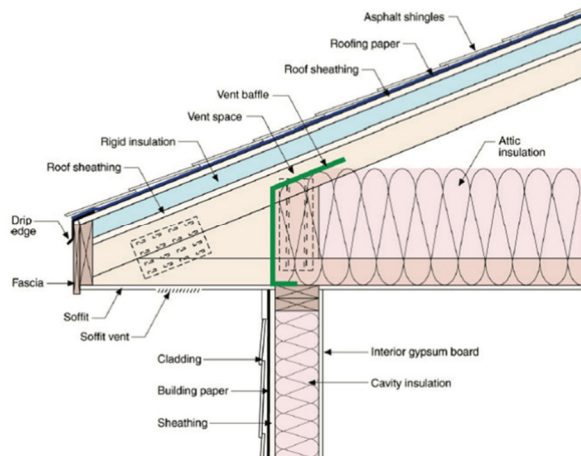
Vented attic with batt, spray in cellulose/fiberglass secured with netting, or SPF. Ceiling insulation required separately above finished attic ceiling.

Option C

Vented attic with no insulation at roof deck. Ceiling insulation required separately above finished attic ceiling.

Ducts and air handler equipment in conditioned space that is NOT a sealed attic.

OPTION A



OPTION B

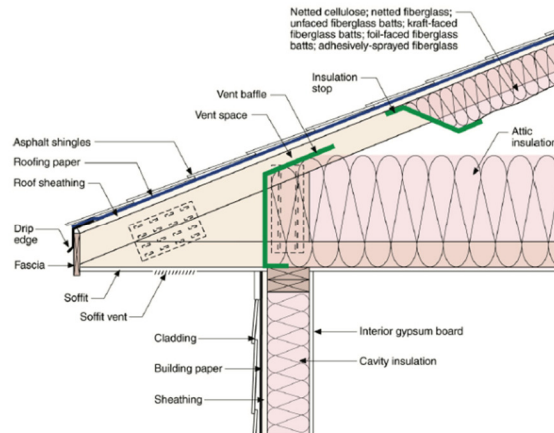


Figure 1: Venting Details for Modified Conventional Vented Attic

Source: Building Science Corporation

Mandatory Lighting Requirements

1. All lighting fixtures must be high efficacy as defined by C.E.C.
2. Table 150-0-A contains definition
3. Luminaires with interchangeable fixtures must contain compliant lamps
4. No screw based sockets
5. No kitchen lighting calculations, all fixtures high efficacy
6. All fixtures controlled by dimmer or vacancy sensor
7. Vacancy sensors mandatory in following rooms:
 - a. Bathrooms
 - b. Garages
 - c. Laundry
 - d. Utility rooms (min 1 fixture in room)
8. "Additions" are treated the same as newly constructed buildings, so they must meet the applicable residential lighting requirements.
9. For alterations, existing luminaires may stay in place but any new permanently installed luminaires shall meet the applicable requirements.

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Compliant Luminaire Types

| High Efficacy Luminaires* | JA8 High Efficacy Lighting – Lamps and Light Sources that must be JA8-certified | *Recessed Downlight Luminaires in Ceilings |
|--|---|---|
| <ul style="list-style-type: none"> • Pin-based linear fluorescent • Pin-based compact fluorescent • Pulse-start metal halide • High pressure sodium • GU-24 other than LEDs • Inseparable SSL luminaires installed outdoors • Inseparable SSL luminaires with colored light sources for decorative lighting purpose | <ul style="list-style-type: none"> • Light sources in ceiling recessed downlight luminaires.* • LED luminaires with integral sources • Screw-based LED lamps (A-lamps, PAR lamps, etc.) • Pin-based LED lamps (MR-16, AR-111, etc.) • GU-24 based LED light source • Any source or luminaire not listed elsewhere on this table | <ul style="list-style-type: none"> • Shall not have screw based sockets • Shall contain JA8-certified light sources • Shall meet all performance requirements in §150.0(k)1C |

The number of blank electrical boxes installed < 5 feet above the finished floor shall not be greater than the number of bedrooms. These electrical boxes shall be served by a dimmer, a vacancy sensor, or fan speed control.

Water Heater Mandatory and Prescriptive requirements

1. Isolation valves must be installed on instantaneous water heaters that have an input rating greater than 6.8 kBTU per hour (2 kilowatts [kW]). The valves must be installed on the cold water line leading to the water heater and the hot water line leaving the water heater. Isolation valves simplify this routine maintenance practice, which reduces the cost and burden of maintaining the water heater.
2. Storage water heaters do not need to have blankets anymore. The *2013 Energy Standards* required storage water heaters with efficiency levels equivalent to the minimum federal efficiency standard to be externally wrapped (such as with a water heater blanket) with insulation of R-12 or greater. This requirement has been deleted. With the amended federal standards that went effect on April 16, 2015, external insulation of water heater storage tanks is no longer cost-effective.
3. For alterations, all newly installed hot water piping and existing accessible piping must be insulated if installing new piping at the time an existing water heater is replaced (that is, replacement water heating systems).

The 2016 prescriptive requirements for single-family buildings and multifamily buildings with a dedicated water heater in each dwelling unit are as follows:

Option 1:

Install a natural gas or propane instantaneous water heater that meets the minimum requirements in California's *Title 20 Appliance Efficiency Regulations*, Section 1605.1(f) for federally regulated appliances.

Option 2:

Install a natural gas or propane storage water heater with a rated storage volume of 55 gallons or less that meets the minimum requirements in California's *Title 20*

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Appliance Efficiency Regulations, Section 1605.1(f) for federally regulated appliances. In addition, the building must comply with the HERS-verified Quality Insulation Installation (QII) requirements), as well as one of the following requirements:

1. HERS-verified compact pipe insulation
2. HERS-verified compact hot water distribution design

Option 3:

Install a natural gas or propane storage water heater with a rated storage volume more than 55 gallons and an input rating of 105,000 BTU/hr or less. The water heater must meet the requirements in California's *Title 20 Appliance Efficiency Regulations* Section 1605.1(f) for federally regulated appliances. In addition, the building must comply with one of the following:

1. HERS-verified pipe insulation

To facilitate future installations of high-efficiency equipment, the Energy Standards contain the following mandatory requirements for systems using gas or propane water heaters that serve individual dwelling units.

1. All water heaters must have 120V receptacle located with 3 feet of water heater.
2. Must have either Category III or IV vent or type B vent straight with no bends. Condensate drain 200,000 btu/hr gas supply line (typically 3/4" pipe).

Solar Ready

The intent of the solar-ready requirements is to provide a penetration-free and shade-free portion of the roof, called the *solar zone*. This solar zone helps ensure that future installation of a solar energy system is not precluded by the original design and layout of the building and associated equipment. There are no infrastructure related requirements, such as installation of conduit or piping, inclusion of collateral structural loads, or preinstalled mounting hardware.

The requirements for solar-ready buildings are mandatory measures for newly constructed single-family and low-rise multifamily residential buildings and do not apply to either additions or alterations.

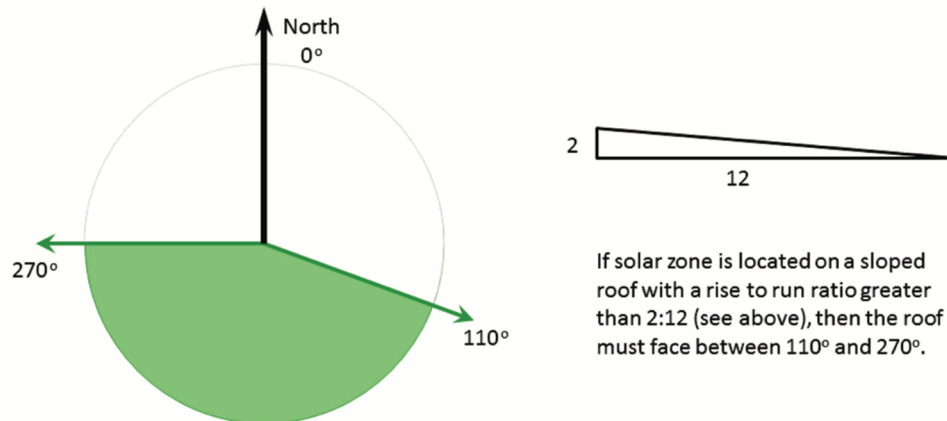
All solar ready provisions are mandatory; there are no prescriptive and performance compliance paths. Since the provisions are mandatory, there are no tradeoffs allowed, and applicants must demonstrate compliance with each measure. There are, however, exceptions. Exceptions to mandatory requirements are described in the corresponding sections.

Must provide a penetration free and shade free portion of the roof called the solar zone to allow future installation of solar PV system. This requirement ensures that the solar zone remains clear and open for the future installation of a solar energy system.

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Orientation:

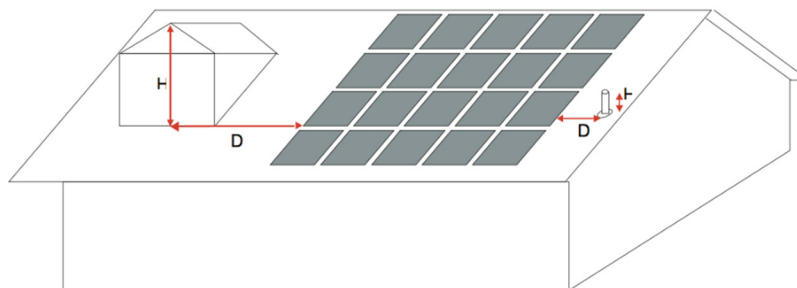
For both single-family residential and low-rise multifamily buildings, all sections of the solar zone on steep-sloped roofs (ratio of rise to run of greater than 2:12) shall be oriented between 110 degrees and 270 degrees of true north. The orientation is important because it ensures a reasonable solar exposure if a solar energy system is installed in the future.



If a solar zone is located on a low-sloped roof (ratio of rise to run of 2:12 or less), the orientation requirement does not apply.

Any obstruction located on the roof or any other part of the building that projects above the solar zone shall be located at a sufficient horizontal distance away from the solar zone in order to reduce the resulting shading of the solar zone. For each obstruction, the horizontal distance (“D”) from the obstruction to the solar zone shall be at least two times the height difference (“H”) between the highest point of the obstruction and the horizontal projection of the nearest point of the solar zone (see following equation).

Equation 7.1 $D \geq 2 \times H$



Source: California Energy Commission

Construction Documents and Structural Design Loads

Construction documents must include information about the as-designed structural loads and plans for interconnecting a photovoltaic (PV) and SWH system to the electrical or plumbing system of the building.

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For the areas of the roof designated as the solar zone, the structural design loads for roof dead load and roof live load shall be clearly indicated on the construction documents. This is required so that the structural loads are known if a solar energy system is installed in the future. There are no requirements for the inclusion of any collateral loads for future solar energy systems.

Main Electrical Service Panel

This requirement applies only to single-family residential buildings. The main electrical service panel shall have a minimum busbar rating of 200 amps and shall have a reserved space to allow for the installation of a double-pole circuit breaker. The reserved circuit breaker space shall be on the opposite (load) end from the input feeder or main circuit location. The reserved circuit breaker space shall be permanently marked as "For Future Solar Electric". These items are required to simplify the possible future installation of a solar electric system.

Review

A certificate of occupancy shall be issued by the local building department before a building can be occupied and limits the building to its intended use for which the certificate was issued. Future changes in occupancy of buildings require a new certificate of occupancy from the building official. A change in a building's use or its portion without any change in its occupancy classification shall require a new certification of occupancy.

"Horizontal exit" now refers to compartmentalized aspect of using a horizontal exit vs the path of egress. This implied three distinct parts: the exit access, the exit and the exit discharge.

Definition of the treated wood has changed to clarify that approved treatment methods by other than pressure are acceptable – code book refers to Wood Products.

Small food processing and commercial kitchens not associated with dining not more than 2500 square feet are Group B occupancy.

Large sized food processing facilities and commercial kitchens not associated with dining facilities more than 2500 sq. ft. are Group F-1.

12 Occupancy Groups – added Organized Camps Group C

Glazing:

Standard or ordinary glass windows

- Each pane shall bear the manufacturer's mark designating the thickness of the glass or glazing material
- The U-factor and SHGC (Solar Heat Gain Coefficient) requirements have been increased
- The base-line, standard window required for compliance with most prescriptive packages is dual pane/vinyl window with Low-E, spectrally selective coating

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- Standard dual pane/metal framing windows even with a thermally broken gasket isolating the glazing from the framing will not comply with the new standards

Tempered glass windows

- Tempered shall be permanently identified by the manufacturer (does not include tempered spandrel glass)
- Tempered glass is glass has been processed by controlled thermal or chemical treatments to increase its strength
- The identification mark or “bug” shall be acid etched, sand blasted, ceramic fired, laser etched, embossed or of a type that, once applied, cannot be removed without the glass being destroyed
- Tempered glazing is required if the bottom edge of the window glazing in the bathing compartments, saunas and steam rooms is less than 60” above the shower floor

Safety glass (AKA Laminated Glass)

- All safety glass shall be “bugged”.
- Safety glass is made with plates of plastic or resin or other material between two sheets of glass to prevent shattering.
- Safety glazing is also required in swinging doors, storm doors and sliding door assemblies.
- It is used for windows adjacent to tennis or sports courts.
- Hazardous locations requiring safety glazing (requiring safety glazing or guards)
 - Within 24” of either side of door (sidelights)
 - Within 24” of a return wall perpendicular to the hinge side of the door
 - If the glazing is 9 square feet or larger in windows, doors, etc.
 - If the bottom edge of the glazing is less than 18” AFF
 - If the top edge of the glazing is more than 36” AFF
 - If the walking area is within 36” horizontally in a straight line of the glazing (low mounted section of windows)

Fire resistant glazing (i.e. 20-minutes glass in doors for fire walls in corridors)

- Glass shall bear a label or other identification permanently affixed to the glass showing manufacturer, test standard and fire resistant rating in minutes

Room illumination must average 10 foot-candles over the area of the room at a height of 30 inches AFF. The stairways shall have an illumination level on tread runs of not less than 1 foot-candle.